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Quantifying and Improving Performance of the XGC code to Prepare for the Exascale KAI GERMASCHEWSKI, University of New Hampshire, C.S. CHANG, JULIEN DOMINSKI, ROBERT HAGER, SEUNG-HOE KU, AARON SCHEINBERG, Princeton Plasma Physics Laboratory — The Exascale Computing Project "WDMApp" develops high-fidelity whole device modeling software for magnetically confined plasmas, relevant to the performance of future fusion reactors such as ITER by coupling core and edge gyrokinetic codes. We will focus primarily on the performance of the XGC code itself, as well as the performance implications of using various methods coupling methos provided by ADIOS2. For XGC, it is expected that the main computational bottlenecks are going to be the electron push kernel as well as the collision operator. For the electron push, we are going to analyze the performance of various implementations: regular Fortran, CUDA-Fortran, Fortran driven by Kokkos/Cabana as well as C++ with Kokkos/Cabana. We will quantify how the performance-portable Kokkos/Cabana approach compares to hand-coded kernels. XGC implements a fully nonlinear Landau collision operator based on continuum representations. For ITER, it is expected that many charge states of Tungsten to be tracked, which increases the computational cost significantly, as it scales with the square of the number of species. We will investigate both computational approaches to reduce the cost (e.g., optimized GPU implementation, pre-calculated matrices), as well as possible algorithmic changes.

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